



Spitzer Space Telescope Research Program for Teachers and Students: Using Spitzer data in *your* classroom with (relatively) simple software



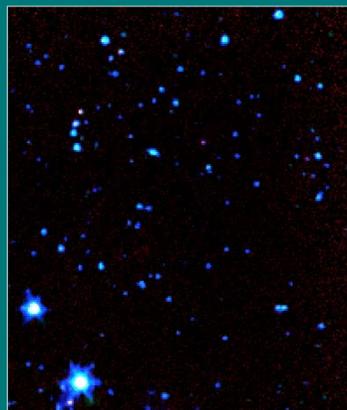
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INTRODUCTION

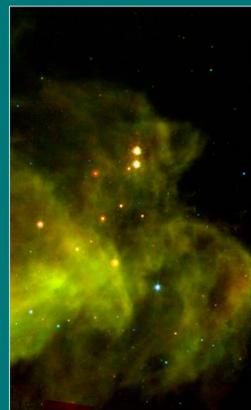
The Spitzer Space Telescope Teacher Program is a collaboration between the Spitzer Science Center and the National Optical Astronomy Observatory. Through this program, twelve teachers were selected to submit observing proposals for time on the Spitzer Space Telescope. The *Intergalactic Star Formation in Tidal Dwarf Galaxies of M81* Project was one of those selected and awarded director's discretionary observing time to study a small region of an M81 tidal tail. This region has previously been observed at optical wavelengths and contains a candidate tidal dwarf galaxy. The four teachers involved in this project met at the Spitzer Science Center in July 2006 to analyze the data, using the SSC's MOPEX software and MaxIm DL software. MOPEX is generally too difficult for students to learn and is not easily accessible to students and teachers. MaxIm DL is software that is readily available in public schools (at a cost <\$500) and offers a graphical interface that can be easily manipulated by high school students. Using MS Excel, the teachers were able to generate a simple conversion table to convert MaxIm DL photometry values into flux and magnitudes. The values obtained by MaxIm DL were compared to values obtained by both MOPEX and SExtractor software and were found to be comparable. In addition to its potential use for photometry with students, MaxIm DL can be used to produce three-color images. For science results using these data, please see our companion poster, Hedden et al. For additional examples of using these tools, we also show data from the study of IC2118, another Spitzer Teacher Project. For Science results from these data, please see our companion poster, Spuck et al.

PROBLEM

- The teachers involved in this Spitzer program wanted to access Spitzer data in their classroom, with students. The Spitzer data is provided in FITS format, requiring some image processing software.
- Most teachers do not have access to professional image processing software, such as IDL, MOPEX or SExtractor, and this software is too difficult for students and teachers to learn and use.
- MaxIm DL is a possible option for more accessible image processing software but photometry is problematic: MaxIm DL only provides intensity values in counts/pixel. These values must be converted into Janskys or magnitudes, which can be complicated for students.



LEFT: Tri-Color image produced of studied M81 region (3.6, 4.5 and 8 μ m)



RIGHT: Tri-Color image of the IC2118 region in 3.6, 8 and 24 μ m. Please see companion poster Spuck et al.

Both images produced by E. Sharma, a student at Lincoln High School, using MaxIm DL and Spitzer FITS data

CREATING TRI-COLOR IMAGES IN MAXIM

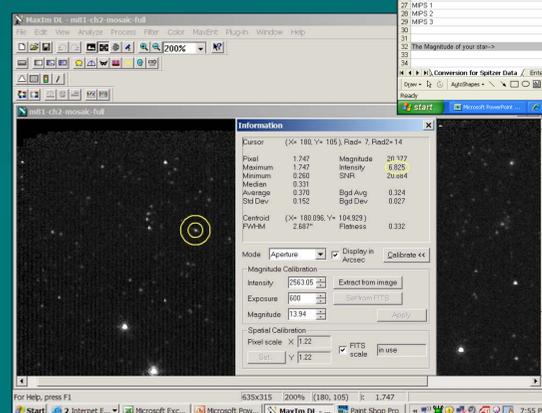
- MaxIm DL allows you to make tri-color images of downloaded Spitzer FITS images, with just simple alignment procedures. The program allows you to determine which color will be shown for which wavelength. The standard is to chose blue for shorter wavelengths and red for longer wavelengths. See sample student tri-color images above.
- MaxIm DL also allows for animation of several images, at various speed settings. This can be useful for finding appearing and disappearing features.
- For full instructions, see handout or go to coolcosmos.ipac.caltech.edu/cosmic_classroom/teacher_research/products.shtml

SOFTWARE REQUIRED:

- MaxIm DL Image Processing Software: Distributed by Cyanogen - www.cyanogen.com
- Microsoft Excel with conversion spreadsheet, available via download from http://coolcosmos.ipac.caltech.edu/cosmic_classroom/teacher_research/products.shtml
- In addition: Recommended Spitzer Teachers Handbook, also available at above site

RIGHT: Sample Excel conversion table. Note that students must manually enter values from the FITS header, as well as the measured intensity; the spreadsheet converts intensities to Janskys and magnitudes.

1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100



LEFT: Sample MaxIm window. Note the aperture tool and the intensity value. This value is entered into the spreadsheet (above) to get general flux and magnitude values.

METHOD FOR OBTAINING FLUX

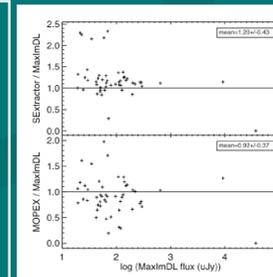
A simple spreadsheet program was created that converts MaxIm DL intensity values into magnitude and flux. For full instructions, see accompanying handout or to download this conversion spreadsheet go to: coolcosmos.ipac.caltech.edu/cosmic_classroom/teacher_research/products.shtml

Simplified Instructions are as follows:

- Go to View on the tool bar, and select "FITS Header info". Record the information listed under CDELT1 and CDELT2. This is the Degree per Pixel scale of your image.
- Go to View on the tool bar, and select "Information Window". Set the mode setting to astrometric.
- Move the cursor around on the image; note the information changing in the window. You will get the x,y for the cursor, and the x,y for the centroid. The centroid is just the center of the object you are on. Below the x,y in each case you will have RA and DEC.
- The intensity of the object shows up to the right of the centroid RA/DEC.
- Open the Excel Conversion spreadsheet. Enter the CDELT1 and 2 values and the RA/DEC of your star. The Excel spreadsheet will convert your measured intensity into flux and magnitude.
- This information can then be used to produce an SED (Spectral Energy Distribution).

FLUX COMPARISON

Using MaxIm DL, ~50 photometric measurements (counts/pixel) for point sources in the M81 region were obtained and converted (using the spreadsheet conversion) to Janskys. The same sources were measured using MOPEX and SExtractor software. To the right is a log/log flux comparison of those values for IRAC 3.6 μ m (where the PSF is the most undersampled and photometry is the hardest). There is a reasonably close correlation between the programs (additional analysis including parameter optimization is pending). We conclude that MaxIm DL is appropriate for student work to ~15% accuracy with respect to professional astronomy programs.



ACKNOWLEDGMENTS: This project was funded by the Spitzer Space Telescope Observing Program for Students and Teachers, a joint project of NASA and NOAO. We also acknowledge the NOAO Teacher Leaders in Research Based Science Education Project funded by the National Science Foundation under ESI 0101982, funded through the AURA/NSF Cooperative Agreement AST-9613615. NOAO is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.

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